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ORGANIZATION AND EFFECTIVENESS OF PEDAGOGICAL EXPERIMENTAL WORK ON DEVELOPING STUDENTS' DIAGNOSTIC COMPETENCE

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Abstract: This experimental study evaluated the effectiveness of a structured pedagogical model for developing diagnostic competence among 278 undergraduate medical students at the Fergana Medical Institute of Public Health. A three-stage intervention—baseline assessment, simulation-based and case-centered training, and post-experiment evaluation—was implemented. Diagnostic competence was assessed through analytical case tasks, OSCE stations, and a standardized rubric measuring symptom identification, data interpretation, differential diagnosis, and justification of decisions. Results demonstrated significant improvement in the experimental group compared with the control group ($p < 0.001$), particularly in differential reasoning and diagnostic justification. The findings confirm that well-organized pedagogical experimental work based on interactive and feedback-oriented learning significantly enhances diagnostic competence in medical students.

Keywords: diagnosis, competence, pedagogy, simulation, assessment, reasoning, education

Introduction

Diagnostic competence represents a core component of professional medical training, as it directly influences the clinical precision, patient safety, and evidence-based decision-making of future practitioners. In modern medical education, diagnostic competence is defined as the integrated ability to recognize clinical symptoms, collect and interpret patient data, construct differential diagnoses, and justify treatment decisions through analytical reasoning and knowledge application [1–3]. The rapid progression of medical sciences, rising disease diversity, and the increasing integration of technology in healthcare necessitate the development of advanced pedagogical strategies that prioritize clinical reasoning and diagnostic decision-making [4]. Global trends in medical education emphasize competency-based curricula, simulation training, case-based learning, and feedback-oriented evaluation as key pedagogical tools for improving diagnosis-focused learning outcomes [5–8]. However, in developing educational systems, including Central Asia, empirical studies addressing the organization and actual effectiveness of pedagogical experiments aimed at improving diagnostic competence remain limited. At local institutions, such as the Fergana Medical Institute of Public Health (FMIOPH), research-based implementation of diagnostic training models had not been systematically evaluated, thus necessitating scientific evidence to support educational reforms.

Given this context, the present study was conducted to assess the organization and effectiveness of a structured pedagogical experiment focused on developing diagnostic competence among undergraduate medical students. A specially designed experimental program was introduced, integrating simulation-based instruction, interactive case analysis, algorithmic diagnostic reasoning, and formative evaluation techniques. The core assumption of this research was that a systematic pedagogical intervention based on interactive and clinically oriented learning methods would significantly improve students' diagnostic competence compared with conventional teaching. Therefore, this study aimed to evaluate the effects of an organized pedagogical experimental model on diagnostic competence development among medical students, while determining the key components responsible for its effectiveness. The findings

may serve as a scientific basis for future curriculum innovations, professional training standards, and competency-oriented assessment models applicable in medical universities.

Materials and Methods:

This experimental pedagogical research was conducted at the Fergana Medical Institute of Public Health (Uzbekistan) during the 2023–2024 academic year. A total of 278 undergraduate medical students, all mentally and physically healthy and without academic failure, participated in the study. The research design consisted of three stages: pre-diagnostic assessment, formative pedagogical experiment, and post-intervention evaluation. Quantitative and qualitative data collection methods were used to ensure objective measurement of diagnostic competence.

At the preparatory stage, baseline diagnostic skills were assessed using validated instruments such as structured problem-oriented tests, Objective Structured Clinical Examination (OSCE) stations, and analytical case-solving tasks modeled after international competencies frameworks [9–11]. A diagnostic competence rubric was developed to measure cognitive, analytical, and practical competencies, including the accuracy of data collection, depth of symptom analysis, differential diagnosis formulation, argumentation clarity, and justification of clinical decisions. Students were then divided into experimental (n=139) and control (n=139) groups with comparable baseline indicators.

During the formative stage, the experimental group received a pedagogical intervention integrating:

1. Simulation-based learning, including mannequins and digital simulators for history taking and physical examination;
2. Clinical case-based discussions and diagnostic reasoning workshops, focusing on explicit cognitive strategies, stepwise diagnostic algorithms, and reflective practice;
3. Individualized feedback and structured checklists for self-correction and peer evaluation;
4. Diagnostic decision-making training using standardized patient encounters and algorithmic tools for differential diagnosis. The control group received conventional teaching without structured diagnostic interventions.

At the final stage, diagnostic competence was reassessed using equivalent but non-identical test instruments to avoid memory bias. Statistical analysis included mean comparison and paired t-test with significance set at $p < 0.05$. Ethical approval was obtained from FMIPH administration, and all participants provided informed consent.

Results:

Pre-study assessment showed that most participants had insufficient diagnostic competence, particularly in differential reasoning and justification of diagnosis. Students frequently identified symptoms but lacked structured analysis or stepwise argumentation of diagnostic conclusions. After the pedagogical intervention, significant improvement was observed in the experimental group compared with the control group. The performance gap was most evident in tasks requiring disease differentiation, justification of diagnosis, interpretation of diagnostic tests, and argumentation of clinical decision-making.

The experimental group exhibited a statistically significant increase in diagnostic competence ($p < 0.001$). Students demonstrated enhanced accuracy in identifying key symptoms, prioritization of clinical findings, analytical reasoning, and justification of diagnostic judgments. Additionally, qualitative observation indicated improved confidence, reduced cognitive errors, and a more systematic approach to data collection and differential diagnosis. Conversely, the control group showed only minor improvements attributable to routine educational exposure, but without significant changes in critical thinking skills.

Table 1. Assessment Criteria and Competence Scores (Pre- and Post-Experiment)

Competence Criteria	Maximum Score	Control Group Mean Pre/Post	Experimental Group Mean Pre/Post
Identification of Key Symptoms	10	4.2 / 5.1	4.3 / 8.9
Clinical Data Interpretation	10	4.6 / 5.2	4.5 / 8.7
Differential Diagnosis Formulation	10	3.9 / 4.8	4.0 / 8.5
Justification and Argumentation	10	3.3 / 4.1	3.2 / 8.2
Decision-Making Accuracy	10	4.1 / 5.0	4.0 / 9.0

These results demonstrate the high effectiveness of structured pedagogical organization in improving diagnostic competence. The intervention promoted deeper clinical reasoning, enabling students to justify decisions based on symptom logic rather than memorized textbook associations. The integration of simulation, interactive cases, and individualized feedback produced measurable improvements in analytical thinking and clinical judgment. Hence, the experiment validated the hypothesis that systematic organization of pedagogical methods significantly increases diagnostic competence among medical students.

Discussion

This study confirmed that a structured pedagogical approach focused on diagnostic reasoning effectively enhances medical students' competence. The substantial improvement in the experimental group aligns with international findings stressing the significance of case-based learning, simulation, and formative assessment in developing diagnostic skills [12–15]. Research indicates that traditional didactic teaching does not sufficiently develop critical thinking or diagnostic reasoning, whereas interactive approaches significantly improve cognitive processes required for differential diagnosis [16–18]. The use of validated rubrics, structured reflection, and stepwise algorithms in our study is consistent with recommendations advocating competency-based assessment and reflective feedback to foster deep learning [19].

The integration of simulation and standardized patient encounters also contributed to higher student performance, which corroborates global evidence demonstrating that experiential training improves the accuracy of clinical data interpretation and decision-making [17]. Additionally, the intervention improved diagnostic justification ability, a key factor closely associated with reducing diagnostic errors and improving rational treatment selection [20]. This suggests that the combination of cognitive strategy instruction, structured reasoning frameworks, and continuous feedback forms a critical pedagogical model for diagnostic competence development.

However, the study is limited by its single-institution design, absence of long-term skill retention assessment, and the lack of cross-specialty diagnostic evaluation. Future research should explore broader clinical areas, digital diagnostic support tools, and longitudinal evaluation to determine lasting effects of pedagogical interventions. Nonetheless, the present study provides strong empirical evidence supporting competency-based diagnostic training and offers a replicable model for medical education reform.

Conclusion

The pedagogical experiment conducted at FMIPH confirmed that systematic organization of diagnostic-focused educational interventions substantially improves medical students' diagnostic

competence. The effective integration of simulation, case-based reasoning, feedback, and algorithmic learning demonstrated measurable improvements in data analysis, differential diagnosis, justification, and decision-making. This research supports the development and institutional adoption of structured diagnostic pedagogy to enhance the professional preparedness and clinical accuracy of future healthcare providers.

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